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(54) A METHOD AND AN APPARATUS FOR DISTRIBUTING A DISINTEGRATED MATERIAL ONTO A LAYER FORMING SURFACE

(71) I, TORSTEN BENGT PERSSON, of Ravnholtvej 164, Testrup, 8320 Maarslet, Denmark, of Danish nationality, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

There is known a method of distributing loose fibres or particles onto a carrier surface constituted by a carrier web, which comprises the steps of feeding the fibre or particle material into a container having a screen wall portion located adjacent one side of said carrier web, agitating the material violently and creating an air flow through the material and through the said screen and web by sucking air from the other side of the web so as to cause the fibres or particles to gradually penetrate the screen and get deposited in a layer on the moving carrier web.

A method of this type and an apparatus for carrying out the method are disclosed, for example, in the British Patent Specification No. 1,207,556. The fibre material is filled into a circular cylindric vat having a plane, perforated bottom constituting the said screen wall portion and located parallel and close to the underlying, moving carrier web. For the agitation of the material near the screen bottom is used a stirring device comprising two vertical rotor shafts mounted in a planet gear arrangement overhead the vat and at their lower ends, just above the screen bottom, provided with radial, vertically oriented impeller fins or blades whirling around in the bottom material layer. Underneath the vat and the moving web is arranged a suction box which draws an air flow through the material in the vat and through the screen bottom and the web, whereby the disintegrated fibres near the bottom are drawn out and deposited on the moving web in a reasonably even layer thereon. The web moves the layer to a binding and curing station in which the layer is made into a non-woven sheet material for one of a wide variety of purposes.

By the agitation of the fibre material it is aimed to ensure that the fibres are kept mixed with the air and are caused to be repeatedly rearranged with respect to the adjoining fibres, whereby they will sooner or later get the opportunity to pass through the fine holes in the screen together with the suction air. The degree of rearrangement of the fibres is highest where the blade edge velocity is highest, i.e. an affective agitation is obtained in an annular area adjacent the outer blade edge portions. However, due to the centrifugal forces which tend to blow the material away from this area, it can be observed that for increasing impeller speed the dispensing capacity of the apparatus increases only to a certain point, whereafter it decreases, and in fact the obtainable maximum capacity is not as high as could be desirable.

According to another known method the fibre material is fed to the cylindric space between a horizontal rotating drum and a screen shell, the drum carrying a higher number of radially protruding needles which serve to disintegrate and rearrange the fibre material. However, the material tends to be moved rapidly through the said space along with the drum surface, and hereby the velocity of the needles relative to the material is not by far as high as the absolute needle velocity, and the ability of the needles to cause rearrangement of the fibres, therefore, and therewith, the dispensing capacity is correspondingly relatively low.

In the known methods described above the fibre material is driven towards the screen only by the suction of air and, as a result, the dispensing capacity is limited.

According to the present invention here is provided a method of distributing loose fibres or particles onto a carrier surface constituted by a moving foraminous carrier web, wherein the material to be distributed is fed to and kept fluidized in air in a distributor container extending across the for-

aminous web and having outlet means through which the material may gradually leave the container in a broad flow directed from one side of the foraminous web towards a transverse surface area thereof, air os sucked through the web from the other side thereof to ensure deposition of the material on the web in a well defined manner, a flow of air fluidized material is created in the container generally transversely of the moving foraminous web, and selected portions or the material flow are subjected to positive displacement forces created by power exerting means located inside said container to impart to a portion of the material in each respective cross section of the material flow a component of movement directed crosswise of the transverse flow direction and towards said outlet means, thereby to promote flow of material through the outlet means independently of the suction of air through the foraminous web.

Imparting displacement forces to selected portions of the fibre material in the direction towards the outlet means allows the dispensing capacity to be increased independently of the air suction.

In a preferred method the flow of air fluidized material is created by the action of impeller wings rotated so as to urge by whipping action the material in said transverse direction along a transverse classification screen wall portion of said container.

The term "whipping" as used here, in the following description and in the appended claims is intended to be indicative of the act of repeatingly moving through the material to be whipped a relatively narrow beat member proportions so as to cause disturbance in the configuration of portions of the material along the moving path of the beat or whip member through the material, without any substantial degree causing the material to move in the beating direction, such that the material portions along the moving path of the beat member are vividly separated and displaced. When a dry fibrous or otherwise loose material is whipped in this manner in air the fibres or particles are kept in air fluidized condition, and the whipping involves a high degree of rearrangement of the fibres or particles without forcing these to move along with the whip or beat members, and consequently the fibres or particles are readily sucked out through the holes in the screen wall portion, whereby a high dispensing capacity is ensured. An increased whipping speed primarily involves an increased rate of rearrangement of the fibres or particles and therewith an increased dispensing capacity within wide limits.

In practice it may be troublesome to effect whipping of the material adjacent all surface portions of the screen wall of the container, but tests have shown that excellent results are obtainable if the whipping is effected in spaced areas along the screen wall, the material being caused to flow, relatively slowly, from one whipping area to the next. Once whipped the material remains in its air fluidized condition for some time, and if the whipping is repeated soon thereafter by virtue of the material being moved to the next whipping station along the screen the fibres or particles even in the material flow between the whipping stations will be readily dispensable through the screen holes.

The said movement of the material from one whipping station to the next and so forth is easily obtainable by means of the whipping members themselves by moving them in a unidirectional manner adjacent the screen so as to cause a general, relatively slow material movement therealong. This movement may well be rapid, in an absolute sense, but far less rapid than the velocity of the whipping members.

The invention further comprises an apparatus for carrying out the method of the invention, comprising a container for the fibre material extending across said carrier web and having inlet means for fibre material and fibre outlet means through which the fibre material may gradually leave the container in a broad flow directed from one side of the foraminous web towards a transverse surface area thereof, suction means being arranged at the other side of the foraminous sheet for drawing air through said transverse surface area thereof, means for causing a flow of the air fluidized fibre material generally along the container and transverse to the direction of movement of the foraminous web, and means located inside said container for positively exerting on portions of said material flow a displacement force directed towards said outlet means in order to promote flow of material through the outlet independently of the suction of air through the foraminous web.

Preferably the means for causing the air fluidized material to be moved along the transversely disposed container are constituted by fast moving whip members operable to whip the fibre material immediately adjacent a classification screen wall portion of the container.

The rotary whip members which rotate in a plane non-parallel to the screen wall portion, cause the material to be slung against the screen and therewith promote the penetration of the fibres or particles through the screen wall.

By way of example the invention will now be described in more details with reference to the accompanying drawing, in which:—

Fig. 1 is a side elevation, partly in sec-

tion, of an apparatus according to a preferred embodiment of the invention,

Fig. 2 is a cross sectional side view of this apparatus,

Fig. 3 is a detail of Figs. 1 and 2 as seen from above,

Fig. 4 is a sectional perspective view of Fig. 1,

Fig. 5 is a view of a modified detail, and

Fig. 6 is a general view of a modified apparatus according to the invention.

Fig. 1 shows an elongated fibre distributor container generally designated 1 and shaped with half-rounded end portions, 2, each of which has a vertical, cylindrical upper portion 4 and a downwardly projecting bottom portion 6 of conical shape and a horizontal, half-circular bottom plate 8. The end portions 2 are interconnected by means of vertical side plates 10 between the upper portions 4, and these parts 2—10 are made of non-perforated metal sheet material. Between the side plates 10 and the end portions 6 and 8 there is mounted a screen as a whole designated 12 and penetratable by fibres and air and being of U-shaped cross section corresponding to the end portions 2, i.e. showing a plane horizontal bottom screen portion 14 and two slanting screen portions 16. The container 1 is supported by means of columns 18 crosswise above a horizontal fibre layer forming web consisting of a finely meshed screen or wire netting 20 which is endlessly drawn about rollers 22 and driven by means of a drive station (not shown) in the direction shown by an arrow. A suction box 24 having an exhauster 26 is arranged beneath the screen 12 and the wire netting 20 and supported by means of beams 19 connected onto the columns 18. The suction box is closed in the bottom portion and the sides and has an upper opening 28 located close to the underside of the web 20, sealed thereagainst by means of sealing flanges 30. The suction box is in one side provided with a horizontal slide gate 32 having a curved edge portion 34 for controlling the suction area, as described in more detail below. At one end portion 4 there is provided a bracket 36 supporting a motor 38, which by means of a chain drive 40 drives four vertical axles 42 running in bearings 44 which are mounted onto cross bars 46 which again are supported at the side plates 10. The axles 42 are arranged in a row in the vertical plane of symmetry of the container and each provided with three pairs of diametrically opposed and radially mounted flat, elongated rotor members 48, the lengths of which are adapted in such a way that their tip portions during rotation will sweep areas and further the lowermost rotor members of the slanting screen 16 at a short distance, and further the lowermost rotor members are arranged just above the bottom screen 14. The lowermost rotor members are situated so as to rotate in a common horizontal plane above the bottom screen 14, while the other rotor members are offset and arranged so as to rotate in areas partly overlapping each other.

Along its broad sides the container is provided with exterior wall plates 50 which together with the side plates 10 form a scavenging channel 52 closed at the sides by plate members 54. The wall plates 50 and the plate members 54 reach down closely above the netting 20 and confine a generally triangular space between the slanting bottom screen 16 and the netting 20, which space is shielded from the surrounding air except for the upper opening of the scavenging channel 52. The wall plate 50 has a right angular bending at the lower edge forming an air sluice 56 through which the netting can pass carrying a layer of fibres deposited thereon as described below.

In operation the axles 42 are rotated in the same direction by which the tips of the rotor members are moved at a velocity in the region of 50 meters per second. This speed is suitable for the treating of e.g. cellulosic fibres, but should be adapted according to the desired product and may vary within wide limitations. An airflow is created through the bottom screens 14, 16 via the netting 20, the suction box and out through the exhauster 26. In the same manner air is sucked through the scavening channels 52. A disintegrated material e.g. cellulosic fibre pulp is fed to the container through a fibre spreading inlet 58 up to approximately the level of the uppermost rotor members and agitated by means of the fast rotating members 48, which will thereby whip violently through the material. By the unidirectional rotation of the rotor members the fibre material is generally thrown against the opposed slanting screen walls 16, whereby the material profile will be somewhat as indicated by a dotted line a in Fig. 2. The material supported by the slanting screen walls is forced by the rotor members 48 to move along the respective walls so as to generally move relatively slowly in a flow around in the container along the sides and ends thereof. The fibres hereby passing the areas swept by the rotor members are vividly whipped and rearranged, and they maintain their state of being fluidized until with said flow they reach the next whipping area. Thus, the slanting bottom screens 16 and the outer edge portions of the bottom screen 14 are continuously being swept by an effectively fluidized current of fibres which can thus readily be sucked through the screens 14, 16. Having passed these screens the fibres will follow the suction air and be deposited onto the netting 20

which separates the fibres from the air thus forming a sheet of loose fibre material which by the movement of the netting is carried through the sluice 56 for fixation or other desired purposes.

Some of the fibres are liable to adhere to the inner side of the outer wall 50, 54, but are prevented from this by means of the scavenging air flowing down along the inner side of these walls after being oriented in the channel 52. Sucking some air this way towards the netting implies the advantage that possible areas of smaller thickness of the fibre layer on the netting has a tendency to be filled so as to show the desired evenness of the sheet of loose fibres, since more air will pass through the thinner areas than through the thicker areas, whereby more fibres will be directed from the upper dispersing zone adjacent the screen 16 towards the thinner areas in a concentration higher than generally found above the sheet. In this manner, should the fibres be dispensed at an increased rate from the screen portions adjacent the areas swept closely by the tips of the rotor members, the resulting uneven distribution of the fibres will thus be counteracted. It will be noted that the longest way of fibre passage from the screen to the netting is from the upper screen portions, i.e. the portions located near the highest speed area of the rotor member tips, i.e. the most active areas of fibre dispensing.

The flow of fibre material inside the container is turned at either end sections 2 and thrown around and upwardly along the half cones 6 entering the area adjacent the cylindrical end portions 4 from where the material is guided by means of guide plate members 60 down again along the lengthwise side portions and so forth. During the turning of the flow of material heavy particles or possible clusters of fibres or other scrap matters will concentrate in the area above the cone at the periphery, where they may be removed. For this purpose there is provided a tangential outlet pipe 62 the entrance of which is a horizontal slot partly covered by a slidably mounted plate member 64 for adjusting the height of the slot so as to control the outlet of e.g. scrap matters. It is possible to connect the outlet pipe 62 to recycle means in well known manner.

The rotor members 48 may have any of a variety of shapes for carrying out their whipping function, e.g. as shown in Fig. 5, in which the lower end of the axle 42 is shown carrying two horizontal arm members 48^1 similar to the rotor members 48, but at the outer ends being interconnected by means of two inclined whip members 49. In this case the axles 42 should be spaced from each other so as to permit unidirectional rotation. Preferably the rotor members should have more or less sharpened front edges, while the rear edges can be flat or even be shaped or provided with flap members so as to enforce an areodynamic turbulence, facilitating the fluidizing of the fibres.

The apparatus should not necessarily be provided with three screens 14, 16 of equal mesh, since by diligent choice of screen types it is possible to form a sheet of loose fibres consisting of e.g. two outer layers of one type of fibres and a midlayer of another type, the different types of fibres being sorted by means of the chosen types of screens. Tests have shown that the apparatus is usable even for fibres longer than these normally treated by apparatuses of the type considered.

Fig. 6 shown a modified embodiment in which the agitators are mounted for rotation about horizontal axles. The numerals indicating parts in the previous figures indicates equivalent means in Fig. 6. The container 1 is furnished with a modified bottom portion having a screen 15 the cross section of which is U-shaped with a straight bottom portion. Parallel to this there is arranged two horizontal axles 5 on each of which there is mounted a set of rotor members 148 arranged so as to rotate by means of the motor drive 38, 40, each of the tips of the members 148 sweeping an area close to the screen 15 at a right angle to this. As indicated with rounded tip ends some of the impellers, designated 51, are shaped slightly like a propeller so as to create a general flow of fibres longitudinally along the curved sides of the screen 15 in one direction along one side and in the opposite direction along the other side. Thus, the impellers serve the combined purpose of whipping the material and moving it around in the container.

A very important feature of the invention, common to both the apparatuses shown in Figs. 4 and 6, is that the impellers are arranged so as to rotate in a plane nonparallel to the plane of the screens 15, 16, the tips being close to these so as to maintain a zone of effectively fluidized fibres directed by means of the centrifugal forces towards the screen portions 15, 16 generally in the direction in which the fibres will readily pass through the screens. A feature also common for the two examples is the general flow of disintegrated material along the inner side of the screen portions 15, 16 so as to facilitate an even output of fibres through the screen 15, 16.

The container 1 should preferably, but not necessarily be covered by a lid section (not shown) of screen material permitting an escape of excess air if the fibres are fed through the fishtail inlet 58 by means of transport air exceeding the amount of air

being sucked via the exhauster 26, but keeping the fibres within the container.

The amount of fibres in the container 1 is controlled by controlling the rate of input in accordance with the output rate so as to maintain a constant profile of the fibre flow along the screens. However, experiments have surprisingly shown that it is possible to produce a sheet of evenly distributed profile; it is in fact possible to feed the fibres batchwise into the container and still obtain even layers of fibres on the netting until the container is run practically empty, which is an outstanding advantage of the invention.

The whip members may be of any suitable design, e.g. constituted by wire members, and they may be arranged for rotation in any suitable manner such that the tip portions thereof are moved repeatedly towards and away from the screen portion cooperating with the whip member.

The slide gate 32 for controlling the suction area may be subdivided into sections as indicated with dotted lines in Fig. 3. The sections may then be individually operated so as to adjust the shape of the suction area 28 and in this way control possible variations of the thickness across the sheet of loose fibres, i.e. if the sheet should be provided with a longitudinal zone in which the layer of fibres is thicker or thinner, the section or sections beneath the zone should be positioned so as to increase or decrease respectively the suction area in question. By continuous operation during a longer period of time parts of the screen may be clogged up or choked by fibres or foreign matters, whereby a thinner zone of the sheet may be produced. This can be counteracted by means of the individually operable gate sections and may be controlled by automatic means. It will be appreciated that this method of controlling the thickness of a sheet material formed by suction not only is suitable for correcting the uniformity of the cross section of the sheet, but also can be used advantageously as a control means for the thickness of the sheet in general. This thickness control means may further be used in connections other than that of the present invention, i.e. where material is deposited on a forming surface by means of suction.

It should be noted that the slanting screen walls should preferably be provided with the perforations showing free openings as seen in the direction of the centrifugal forces of the rotor members, thus facilitating the penetration of the fibres through the screen. A minor disadvantage of this would be that some fibres were directed towards the inner surface of the exterior wall plate 50, so as to build up upon these and give rise to the risk of clumps of particles falling down upon the sheet of fibres, but this risk is counteracted by means of the scavenging current through the channel 52. Another way of overcoming this problem could be the substituting of the wall plate 50 by a horizontal roller covering with part of its surface the triangular space between the screen 16 and the web. In this way the fibres deposited upon the roller surface can be continuously removed and the scavenging channel 52 and the sluice 56 may be omitted.

WHAT I CLAIM IS:—

1. A method of distributing loose fibres or particles onto a carrier surface constituted by a moving foraminous carrier web, wherein the material to be distributed is fed to and kept fluidized in air in a distributor container extending across the foraminous web and having outlet means through which the material may gradually leave the container in a broad flow directed from one side of the foraminous web towards a transverse surface area thereof, air os sucked through the web from the other side thereof to ensure deposition of the material on the web in a well defined manner, a flow of air fluidized material is created in the container generally transversely of the moving foraminous web, and selected portions of the material flow are subjected to positive displacement forces created by power exerting means located inside said container to impart to a portion of the material in each respective cross section of the material flow a component of movement directed crosswise of the transverse flow direction and towards said outlet means, thereby to promote flow of material through the outlet means independently of the suction of air through the foraminous web.

2. A method according to claim 1, wherein the flow of air fluidized material is created by the action of impeller wings rotated so as to urge by whipping action the material in said transverse direction along a transverse classification screen wall portion of said container.

3. A method according to claim 2, wherein the said positive displacement forces are created by the action of said impeller wings, these rotating in a plane intersecting the respective adiacent screen wall portions so as to cause fibre material to be thrown against these wall portions by the centrifugal action of the impellers.

4. A method according to claim 2 or 3, wherein the flow of air fluidized material is caused to pass a plurality of impellers located in spaced areas along the screen wall so as to generally support the said flow.

5. A method according to any of claims 1 to 4, wherein the flow of air fluidized material is caused to circulate in said container in one transverse direction along one trans-

verse wall portion and in the opposite transverse direction along an opposed transverse wall portion.

6. An apparatus for depositing and distributing loose fibres or particles onto a carrier surface constituted by a moving foraminous carrier web in accordance with the method claimed in claim 1, comprising a container for the fibre material extending across said carrier web and having inlet means for fibre material and fibre outlet means through which the fibre material may gradually leave the container in a broad aminous web towards a transverse surface flow directed from one side of the forarea thereof, suction means being arranged at the other side of the foraminous sheet for drawing air through said transverse surface area thereof, means for causing a flow of the air fluidized fibre material generally along the container and transverse to the direction of movement of the foraminous web, and means located inside said container for positively exerting on portions of said material flow a displacement force directed towards said outlet means in order to promote flow of material through the outlet independently of the suction of air through the foraminous web.

7. An apparatus according to claim 6, wherein the means for causing the air fluidized material to be moved along the transversely disposed container are constituted by fast moving whip members operable to whip the fibre material immediately adjacent a classification screen wall portion of the container.

8. An apparatus according to claim 7, wherein the whip members are located at mutually spaced locations along the screen wall portion and are arranged to impart to the whipped material a relatively slow general movement along the screen.

9. An apparatus according to claim 8 wherein a number of rotary agitators are mounted with parallel rotation axes extend generally down into the container, the agitators are mounted in a row along the screen and provided with thin whip members, the outermost portions of which pass closely along the adjacent portion of the screen and move in a plane of rotation which is non-parallel to the respective said screen portion, all whip members being rotated with uniform direction of rotation.

10. An apparatus accordng to claim 9, in which the whip members project radially from the shafts of the agitators and in which at least some of the whip members of two adjacent agitators are axially offset from each other and mounted so as to rotate in overlapping circular paths.

11. An apparatus according to claim 9 or 10, in which the container is elongated in the direction transverse to the foraminous web and is provided with one row of said agitators, the container having screen wall portions located at both sides of said row and having rounded nonforaminous ends.

12. An apparatus according to claim 9, 10 or 11, in which the screen wall portion is a lower portion of the container arranged so as to extend generally upwardly and outwardly from a bottom portion.

13. An apparatus according to claim 12, in which the container is provided with a screen wall having a lower flat portion located above and parallel with the foraminous sheet and outer inclined side portions, the whip members being arranged so as to form a correspondingly frusto-conical pattern.

14. An apparatus according to claim 12 or 13, in which there is arranged a wall member so as to confine a space of generally triangular cross-section between the inclined screen wall portion and the foraminous sheet, said space communicating with air intake means for external air.

15. An apparatus according to any one of claims 9 to 14, in which the whip members are constituted by radially projecting rods of flat cross section.

16. An apparatus according to claim 15, in which the opposed larger surfaces of the rods taper towards each other at least adjacent the leading edges of the rods.

17. An apparatus according to claim 8, in which the agitation means comprise a rotary shaft extending generally along the screen and being provided with radial whip or beat fingers of which at least some are shaped in a propeller blade like manner in order to effect displacement of the whipped material in the axial direction of the said shaft, along the screen.

18. A method of distributing loose fibres or particles onto a carrier surface constituted by a moving foraminous carrier web, according to claim 1 and substantially as herein described.

19. An apparatus for depositing and distributing loose fibres or particles onto a carrier constituted by a moving foraminous carrier web, substantially as herein described with reference to the accompanying

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1559274 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

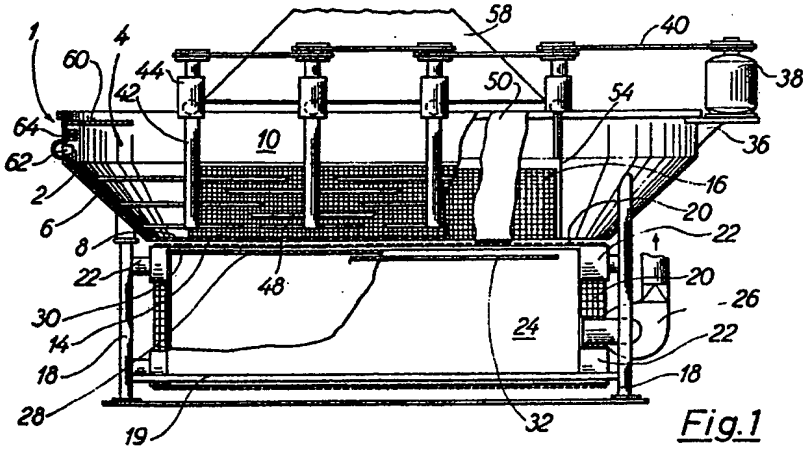

Fig.1

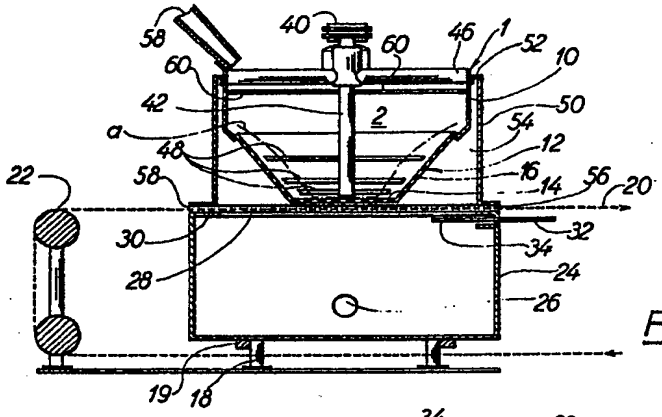

Fig.2

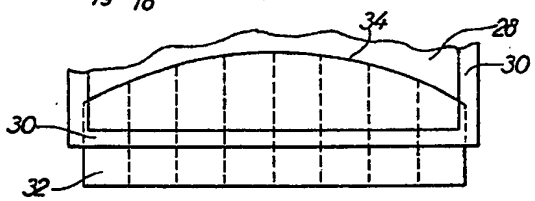

Fig.3

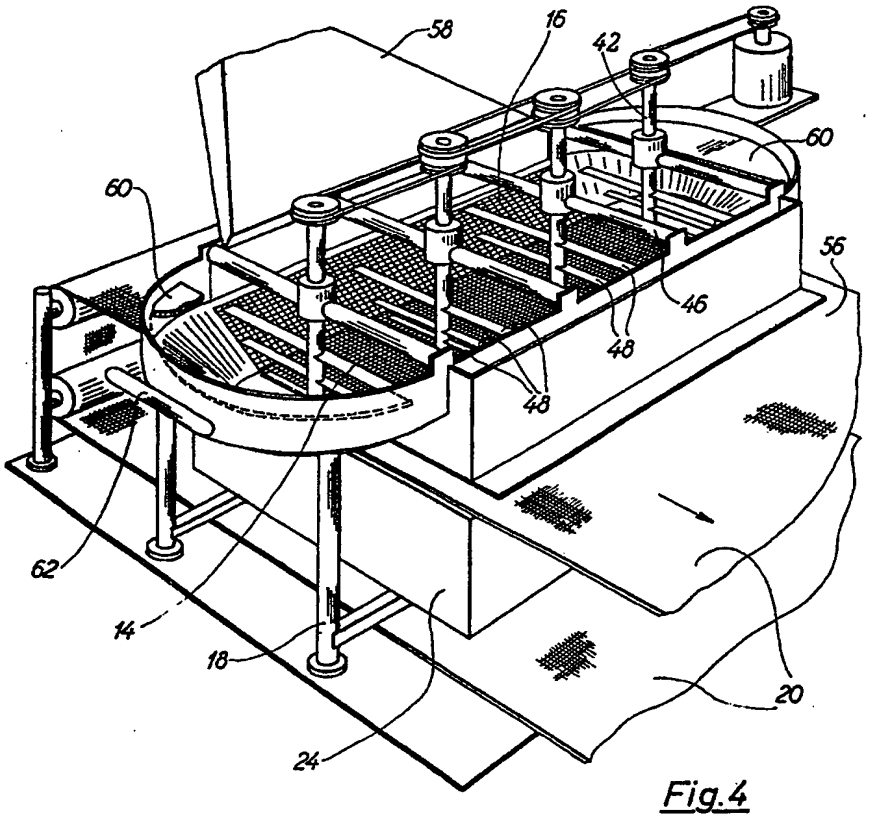

Fig.4

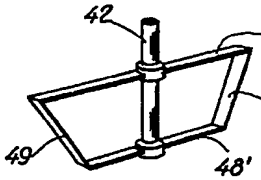

Fig.5

1559274 COMPLETE SPECIFICATION
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 3

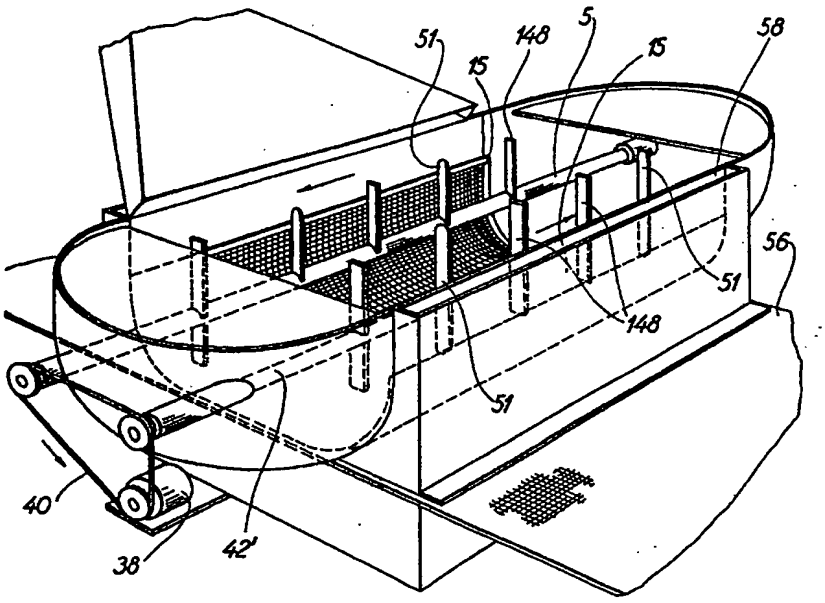

Fig.6